भारतीय मानक

Indian Standard

IS 11315 (Part 11) : 2023

रॉक मास में दरारों के मात्रात्मक विवरण के तरीके

भाग 11 कोर रिकवरी और रॉक क्वालिटी पदनाम

(पहला पुनरीक्षण)

Methods for Quantitative Description of Discontinuities in Rock Masses

Part 11 Core Recovery and Rock Quality Designation

(First Revision)

ICS 93.060

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FOREWORD

This Indian Standard (Part 11) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Rock Mechanics Sectional Committee had been approved by the Civil Engineering Division Council.

A series of Indian Standard on test methods for assessing the strength characteristics of rocks and rock masses are being developed/revised in view of recent advances in the field of rock mechanics. The majority of rock masses, in particular, those within a few hundred metres from the surface, behave as discontinuous, with the discontinuities largely determining the mechanical behaviour. It is, therefore, essential that structure of a rock mass and the nature of its discontinuities are carefully described and quantified to have a complete and unified descriptions of rock masses and discontinuities. Careful field descriptions will enhance the value of *in-situ* tests that are performed since the interpretation and extrapolation of results will be made more reliable.

Discontinuity is the general term for any mechanical discontinuity in a rock mass, along which the rock mass has zero or low tensile strength. It is the collective term for most types of joints, weak bedding planes, weak schistosity planes, weakness zones, shear zones and faults. The ten parameters selected for rock mass survey to describe discontinuities are orientation, spacing, persistence, roughness, wall strength, aperture, filling, seepage, number of sets and block size. These parameters are also evaluated from the study of drill cores to obtain information on the discontinuities.

It is essential that both the structures of a rock mass and the nature of its discontinuities are carefully described for determining the mechanical behaviour. This Indian Standard, covering various parameters to describe discontinuities in rock masses.

This standard (Part 11) covers the methods for quantitative description of discontinuities in rock masses for core recovery and rock quality designation. This standard (Part 11) was first formulated in 1985. This revision incorporates the latest advancement and modifications based on the experience gained in the use of this standard. The other parts formulated in the series are:

Part 1 Orientation
Part 2 Spacing
Part 3 Persistence
Part 4 Roughness
Part 5 Wall strength
Part 6 Aperture
Part 7 Filling
Part 8 Seepage
Part 9 Number of sets
Part 10 Block size
Part 12 Drill core study

The rock quality designation (RQD), is a simple and practical method of describing the quality of core from borings. The geomechanics classification for rock mass rating is more comprehensive. Geomechanics classification although initially developed for tunnels, has been applied to rock slopes and foundations, ground rippability assessment, as well as to mining problems. This code will be helpful in collection of field data for applying the geomechanics classification for use in civil engineering.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

METHODS FOR QUANTITATIVE DESCRIPTION OF DISCONTINUITIES IN ROCK MASSES
PART 11 CORE RECOVERY AND ROCK QUALITY DESIGNATION

(First Revision)

1 SCOPE

This standard (Part 11) covers the method for the determination of core recovery, and Rock Quality Designation (RQD).

2 REFERENCE

The standard given below contains provisions, which through reference in this text, constitutes provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of this standard:

IS No.	*Title*
IS 11358 : 1987	Glossary of terms and symbols relating to rock mechanics

3 TERMINOLOGY

For the purpose of this standard, the definitions of terms given in IS 11358 shall apply.

4 SYMBOLS

4.1 For the purpose of this code, unless otherwise defined in the test, the following symbols shall apply:

RQD	Rock quality designation;
V	P-wave velocity obtained by seismic refraction survey;
V_{r}	Wave velocity of rock material obtained from ultrasonic tests on cores; and
J_{v}	(Number of joints per cubic metre), volumetric joint count.

5 CORE RECOVERY

5.1 General

Core recovery defined as the summed length of all pieces of recovered core expressed as a percentage of length drilled, should be measured and recorded to the nearest 2 percent if possible. When the core is highly fragmented the length of such portions is estimated by assembling the fragments and estimating the length of core that the fragments appear to represent. Fig. 1 shows the calculation of core recovery. Core recovery is normally used to describe individual core runs or whole boreholes. The results obtained in a rock mass of poor quality will be strongly dependent on the drilling equipment and on the skill of the drilling crew.

5.2 Sound rock usually furnishes high recoveries, often about 100 percent, seamy and or jointed rock may furnish low recovery and badly broken cores.

5.3 Precautions

a) Core grinding may result in excessive loss of core. Core that is damaged in this way should always be recorded;

b) Diamond core boring gives smooth and regular cores;

c) The depth drilled at the start and end of zones of core loss should be carefully recorded. The relevant length lost can be replaced by wooden blocks with marking on both ends; and

d) In limestones with solution cavities, the thickness of cavity should be estimated while drilling is going on by nothing sudden increase in rate of drilling.

6 ROCK QUALITY DESIGNATION (RQD)

6.1 General

RQD is a modified core recovery percentage in which all the pieces of sound core over 10 cm long are counted as recovery, and are expressed as a percentage of the length drilled. The smaller pieces resulting from closer jointing, faulting or weathering are discounted. Fig. 1 illustrates calculation of rock quality designation.

6.1.1 The RQD has been found to be a more sensitive and consistent indicator of general rock quality compared to the gross recovery percentage as obtained in Fig. 1.

6.2 Precautions

a) If core is broken during drilling process or handling, the fresh broken pieces should be fitted together and counted as one piece, if the length exceeds the requisite value of 10 cm;

b) Material that is obviously weaker than the surrounding rock such as over consolidated gauge is discounted, even if it appears as intact pieces that are 10 cm or more in length (This type of material will normally be recovered when using the most advanced drilling equipment and experienced or carefully supervised drilling crews);

c) To avoid poor recovery due to drilling equipment or human factor involved, double tube core barrel of NX size (54 mm dia, inside) or NQ size (48 mm inner dia, in case of wireline drilling) are specified and proper supervision is required; and

d) The length of individual core pieces should be assessed along the centre line of the core.

6.3 Indirect Methods (Correlated Values)

In cases where drilling has not been possible indirect method should be used. Out of the two indirect methods, one is based on dynamic testing (*see* **6.3.1**) and the other is based on degree of jointing (*see* **6.3.2**).

6.3.1 RQD is approximately equal to square of velocity ratio multiplied by 100. Velocity ratio is defined as ratio between P-wave velocity (V) obtained from seismic refraction survey in field and wave velocity (V_r) of rock material obtained from ultrasonic tests on rock cores.

$$RQD = \left(\frac{V}{V_r}\right)^2 \times 100$$

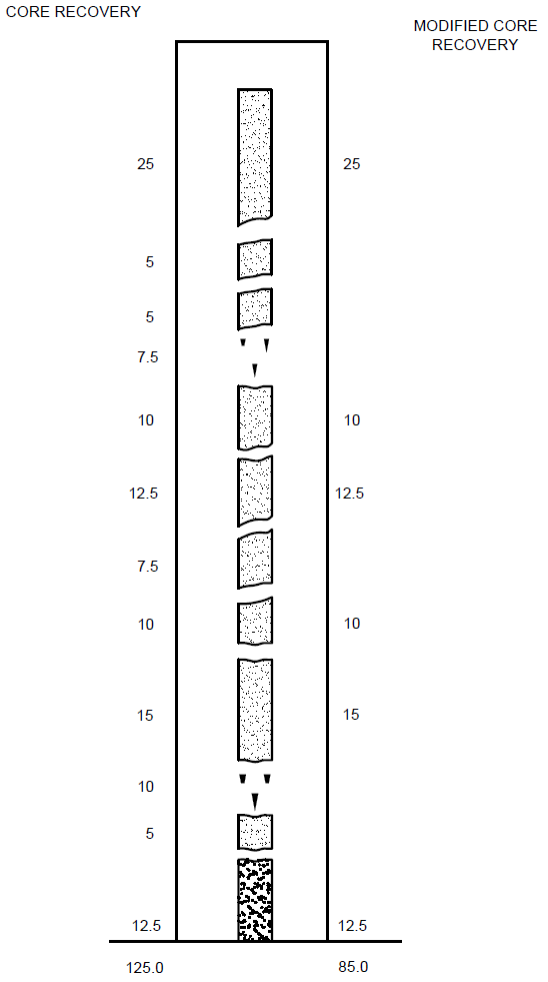

FIG. 1 MODIFIED CORE RECOVERY AS AN INDEX OF ROCK QUALITY

6.3.2 The RQD is approximately correlated to number of joints in a cube of 1 metre as follows:

$$RQD = 115 - 3.3\,J_v$$
$$RQD = 100 \text{ for } J_v < 4.5$$

NOTE — Experience shows that actual RQD is sometimes less than above value.

When RQD is to be estimated from J_v in the construction stage, the RQD are to be validated at places by simulating horizontal drill holes in the drive directions.

Also, equation of palmstrom (2002):

$RQD = 110 - 2.5\,J_v$ (for J_v 4 to 44) could be used.

6.3.3 The core quality shall be classified as under according to: *RQD*

RQD, Percent	*Core Quality*
90 – 100	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
25	Very poor

7 REPORTING OF RESULTS

The result of geological investigations will be reported as follows:

a) Geological description of site;
b) Core recovery; and
c) *RQD*.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Rock Mechanics Sectional Committee, CED 48

Organization	*Representative(s)*
Indian Institute of Technology Roorkee	DR N. K. SAMADHIYA **(*Chairperson*)**
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Amend No.	Date of Issue	Text Affected

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